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ABSTRACT

Crustal Evolution Education Project (CEEP) modules were designed to: (1) provide students with the methods and results of continuing investigations into the composition, history, and processes of the earth's crust and the application of this knowledge to man's activities and (2) to be used by teachers with little or no previous background in the modern theories of sea-floor spreading, continental drift, and plate tectonics. Each module consists of two booklets: a teacher's guide and student investigation. The teacher's guide contains all of the information present in the student investigation booklet as well as: (1) a general introduction; (2) prerequisite student background; (3) objectives; (4) list of required materials; (5) background information; (6) suggested approach; (7) procedure, including number of 45-minute class periods required; (8) summary questions (with answers); (9) extension activities; and (10) list of references. A game approach is used in this module focusing on land investment and development at a site located at a major plate boundary (San Andreas Fault) in California. Objectives include identifying geologic hazards in an earthquake-prone area, identifying probable effects of these hazards on land and development in the area, and stating measures used to minimize effect of these hazards. (Author/JN)

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Quake Estate (board game)

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TEACHER'S GUIDE

Catalog No. 34W1024

For use with Student Investigation 34W1124
Class time: three 45-minute periods

Developed by
THE NATIONAL ASSOCIATION OF GEOLOGY TEACHERS

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NAGT Crustal Evolution Education Project

Edward C. Stoever, Jr., Project Director

Welcome to the exciting world of current research into the composition, history and processes of the earth's crust and the application of this knowledge to man's activities. The earth sciences are currently experiencing a dramatic revolution in our understanding of the way in which the earth works. CEEP modules are designed to bring into the classroom the methods and results of these continuing investigations. The Crustal Evolution Education Project began work in 1974 under the auspices of the National Association of Geology Teachers. CEEP materials have been developed by teams of science educators, classroom teachers, and scientists. Prior to publication, the materials were field tested by more than 200 teachers and over 12,000 students.

Current crustal evolution research is a breaking story that students are living through today. Teachers and students alike have a unique opportunity through CEEP modules to share in the unfolding of these educationally important and exciting advances. CEEP modules are designed to provide students with appealing firsthand investigative experiences with concepts which are at or close to the frontiers of scientific inquiry into plate tectonics. Furthermore, the CEEP modules are designed to be used by teachers with little or no previous background in the modern theories of sea-floor spreading, continental drift and plate tectonics.

We know that you will enjoy using CEEP modules in your classroom. Read on, and be prepared to experience a renewed enthusiasm for teaching as you learn more about the living earth in this and other CEEP modules.

About CEEP Modules...

Most CEEP modules consist of two booklets: a Teacher's Guide and a Student Investigation. The Teacher's Guide contains all the information and illustrations in the Student Investigation, plus sections printed in color, intended only for the teacher, as well as answers to the questions that are included in the Student Investigation. In some modules, there are illustrations that appear only in the Teacher's Guide, and these are designated by figure letters instead of the number sequence used in the Student Investigation.

For some modules, maps, rulers and other common classroom materials are needed, and in varying quantities according to the method of presentation. Read over the module before scheduling its use in class and refer to the list of MATERIALS in the module.

Each module is individual and self-contained in content, but some are divided into two or more parts for convenience. The recommended length of time for each module is indicated. Some modules require prerequisite knowledge of some aspects of basic earth science; this is noted in the Teacher's Guide.

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Quake Estate

INTRODUCTION

Quake Estate is a game approach to land investment and development. Winning the game involves elements of chance as well as opportunities to make decisions based on a knowledge of geologic hazards and their effect on land utilization. The specific site chosen for the game is a simplified version of an existing area located at a major plate boundary in California. In this area the San Andreas Fault has been identified as a transform fault separating the Pacific and North American Plates.

Quake Estate is a game of real environmental problems and decisions. You will play the part of a geologist, investor, and land developer. The game board is a simplified version of an area located at a major plate boundary in California. This area has many hazards. These hazards include earthquakes, landslides, fires, and floods. Geologists, land developers and residents have many problems because of these hazards. The object of the game is to acquire the most money and property. Understanding geologic hazards and their effects on land development and use will help you win the game.

PREREQUISITE STUDENT BACKGROUND

The students should be reasonably familiar with the major geologic hazards associated with the development of a parcel of land in an earthquake-prone area. These include the effect of earthquakes in different rock and topographic settings, landslides, mudslides, flooding, rock and sediment properties as foundation material, and subsidence due to removal of ground water, oil, etc.

OBJECTIVES

After you have completed this activity, you should be able to:

1. Identify the geologic hazards in an earthquake-prone area.
2. Identify the probable effects of these hazards on the land and development in the area.
3. State measures that can be employed to minimize the effect of these hazards.

MATERIALS

Quake Estate game board—one board for two to four students. An expendable or nonexpendable game board may be used. The instructions for each are as follows. (See CEEP Materials List.)

Materials needed to make nonexpendable board:

Student Investigation Worksheet No. 1

White board or white cardboard 26 cm x 33 cm

Spray can or jar of liquid adhesive glue

Colored pencils, crayons or watercolor paints—yellow, blue, orange, purple, green, red and brown

The geologic map and game squares on the game board should be colored as indicated:

Gator Bay, Angel Creek Reservoir and Diablo Creek Reservoir in blue.

Marshland, Tideland and Bayside in yellow.

Meadowside, Plains, Lowland Park and Green Fields in orange.

Rolling Hills, Foothill and Hillside in green.

Bay View, Hilltop and Mountain View in brown.

Heavenly Valley in purple.

Black Mountain, Alpine Crest and Upland Ridge in red.

Four kinds of structures are needed for each game: Single Family Residences (30 pieces), Condominiums (30 pieces), Shopping Centers (20 pieces), and Recreation area (30 pieces).

These materials can be cut from wood or plastic packing foam material. One easy way to prepare them is to buy some lengths of ¼" x ¼" and ⅛" x ¼" balsa strips at your local hobby shop. One length of the ¼" x ¼" can be cut for the Residence structure and painted white, while a double length can be used for the Shopping Center and painted blue. The balsa can be easily cut with a hobby razor saw. While preparing the structures, remember that their size should make it possible to put three structures on any property. The other kinds can be of different sizes and colors.

An expendable version (Worksheet 1) of the game board may be employed. In this case, the students draw a symbol of various developments in each property directly on the game board. If a player adds a development to his or her property, the appropriate symbol is simply drawn onto the top of the appropriate property square with a pencil: □ — single family residence; X — condominiums; $ — shopping center; R — recreation area. When a player finds it necessary to sell a development, the symbol is simply erased or crossed out.

The paper game board, Worksheet 1, may be taped to a piece of cardboard for easier handling.

Materials needed for either expendable or nonexpendable game boards:

Game Cards (Worksheets 3-7)—one set for each game board. These cards should be cut and pasted onto appropriately colored index cards or construction paper. Then, on the back of each colored card, write the name of that kind of game card (Action, Court of Law, Disaster, Geologist's Report, or Property).

Game Money—twenty of each denomination ($1, $5, $10, $20, $50, $100, $500, $1000) for each game board. Play money, poker chips or marked 3x5 cards can serve as game money.

Dice—one pair for each game board.

Game Markers for each player—one set for each game board.

Banker's Insurance Record (Worksheet 2)—one for each game board.

Score Pad—one for each game board.

BACKGROUND INFORMATION

The site selected as the model for the game board is the area portrayed on the Geologic Map of the Palo Alto 15-minute quadrangle, Santa Clara and San Mateo Counties, California. The map was prepared by T.W. Dibblee, Jr., in 1966, and is available from the California Division of Mines and Geology, 1416 Ninth Street, Room 1341, Sacramento, CA 95814; it is listed as Map Sheet 8.

The site is located in the San Francisco Bay Area, a major metropolitan region fraught with geologic hazards. Because of these circumstances, the U.S. Geological Survey (USGS), in coordination with the U.S. Department of Housing and Urban Development (HUD), has completed a pilot study entitled "San Francisco Bay Region Environment and Resources Planning Study." Numerous publications designed to explain the geologic setting to non-professionals are available from: Pacific Environmental Branch, United States Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025.

SUGGESTED APPROACH

The rules for playing the game should be reviewed with the students beforehand.

The following words should be placed on the chalkboard and discussed before playing the game.

topography	**creep**
consultant	**hydroelectric**
piedmont	**Richter scale**
lateral	**tsunami**
marshland	**condominium**
fault zone	**variance**
subsidence	**bedrock**
planning commission	**drought**
alluvium	**tideland**
quicksand	**magnitude**
landslide	**erosion**

PROCEDURE

Key words: none

Time required: three 45-minute periods

Materials: complete set of game materials

RULES

1. Two to four players may play the game. Team play is also an alternative.

2. A Banker must be selected who will handle the finances during play. This can be done by each player throwing the dice, with the highest throw becoming the Banker. Because the Banker is also a player in the game, he or she must also maintain money as well.

Each group of game cards is shuffled and placed face down beside the Banker.

3. To start the game, each player draws a Property Card from the Banker. This becomes the principal place of residence. If a player draws the Water or Power Company, these are put back into the pile and the player draws again.

The players place their markers at Start and collect $1,000 each from the Banker (1-$500, 2-$100, 3-$50, 5-$20, 4-$10, and 2-$5). The order of play is clockwise, with the person to the immediate left of the Banker going first.

4. To advance on the board, each player in turn throws the dice and moves his or her marker the number of spaces indicated.

If doubles are thrown, the player receives an additional turn. If doubles are thrown again the dice are passed to the next player and no additional turn is taken.

If the player lands on an unowned property square, it may be purchased at that time for the amount shown on the square. If the property square is owned, including the Water and Power Companies, the player must pay the rent to the owner shown on the Property Card. Rent is the fee shown on the Property Card plus 10% of total value of all developments made. Insurance is not considered a development.

In addition to the property squares, other squares around the board are named according to matching cards. When landing on these squares, the player draws the appropriate card:

ACTION—indicates some money the player is to pay out or receive.

DISASTER—indicates some geologic hazard that affects all players holding property in the areas indicated.

COURT OF LAW—requires the player to pay out a fee for some legal action.

CONSULTANT—player receives, at no cost, a Geologist's Report about one of his or her properties. (Otherwise, players have the option to purchase the Geologist's Report for the fee shown on the Property Card. The Geologist's Report may be purchased at any time during the player's turn). Geologist's Reports will be helpful in planning developments.

PLANNING COMMISSION—player is given a variance to make a total of three developments on a piece of property, rather than being limited to two as is normally the case (see DEVELOPING LAND). The third development must be made during that move and may not be "saved."

SPECIAL PROPERTY TAXES—player must pay the amount indicated to the Bank.

5. Each time a player passes Start, the player collects $1000 from the Banker.

6. If a player runs out of money but holds property, he or she has the option to sell developments back to the bank at 50% of their original cost, or a property may be sold to any of the other players for the highest bid.

7. The game is over when time has run out or when only one player is left. When time has run out, the winner is the player with the greatest wealth. Wealth is determined by adding the cash and actual cost of all property and developments held by each player. Insurance is not included.

DEVELOPING LAND

All of the property squares except the Water and Power Companies may be developed in only two of the following ways: Recreational Area, Residential Area, Condominium and Shopping Center.

Land may be developed at the time it is purchased or when the player passes the Start square. The cost for each development alternative is shown on the Property Card. In developing the land the player should consider the possible geologic hazards of the property. A player may purchase the Geologist's Report on a piece of property at any time during the player's turn by paying the fee shown on the Property Card. When development occurs, the player puts an appropriate structure on the property. Developments cannot be moved from one property to another.

INSURANCE

Insurance against floods, earthquakes, landslides and fire may be purchased from the bank at the time the property is purchased, developed, or when the player passes Start. The Banker records the kinds of insurance purchased on each property on the Banker's Insurance Record. The cost of the various kinds of insurance are shown on the Property Cards. Insurance covers 100% of the cost of property.

Once purchased, the insurance remains active on a piece of property as long as the property is not sold. When property is sold to the bank or another player, the insurance is cancelled. The new owner must buy new insurance if desired.

Damage caused by tsunami can be covered either by flood or earthquake insurance. Before starting the game, the players must decide which insurance policy will cover damage caused by tsunami.

Insurance may not be sold back to the bank (although developments or the property may be). It has no "trade in" value.

Good luck and plan your investments wisely!

SUMMARY QUESTIONS

1. What is the greatest geologic hazard in a zone of active faulting?

Earthquakes, producing ground shaking and rupture.

2. What is the most significant hazard associated with dams in an area of active faulting?

Dam failure during an earthquake, which results in a large mass of water being released that may cause widespread flooding and damage to downstream areas.

3. What is the greatest hazard associated with coastal areas prone to earthquakes?

Tsunami or seismic sea waves. These can be generated by an earthquake and may lead to widespread flooding and damage to coastal areas.

4. Why may it be dangerous to build a home on a flood plain of a river?

During the rainy season the river may flood the surrounding lowlands.

5. What are the factors you would consider when buying a home in an area prone to earthquakes?

(a) Proximity to an active earthquake fault
(b) Bedrock or soil conditions
(c) Topography of the land
(d) Possibility of flooding by the sea, bay-water, and rivers
(e) Proximity of dams near active faults
(f) Proximity of other structures such as nuclear power stations, fuel lines, and bridges

HELPFUL BACKGROUND MATERIAL FOR CLASSROOM PRESENTATION

There are many good films which can be presented on the day before the activity. Suggested films are:

***City That Waits To Die*, 16 mm, 47 min., color, British Broadcasting Corporation, 1971.**

***San Andreas Fault*, 16 mm, 21 min., color, Encyclopedia Britannica, 1974.**

***The Not So Solid Earth*, 16 mm, 31 min., color, Time-Life, 1970.**

***The Alaskan Earthquake*, 16 mm, 15 min., color, United States Geological Survey, 1966.**

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Schlocker, J., 1974, *Geology of the San Francisco north quadrangle, California*. U.S. Geological Survey Professional Paper 782, 190 p.

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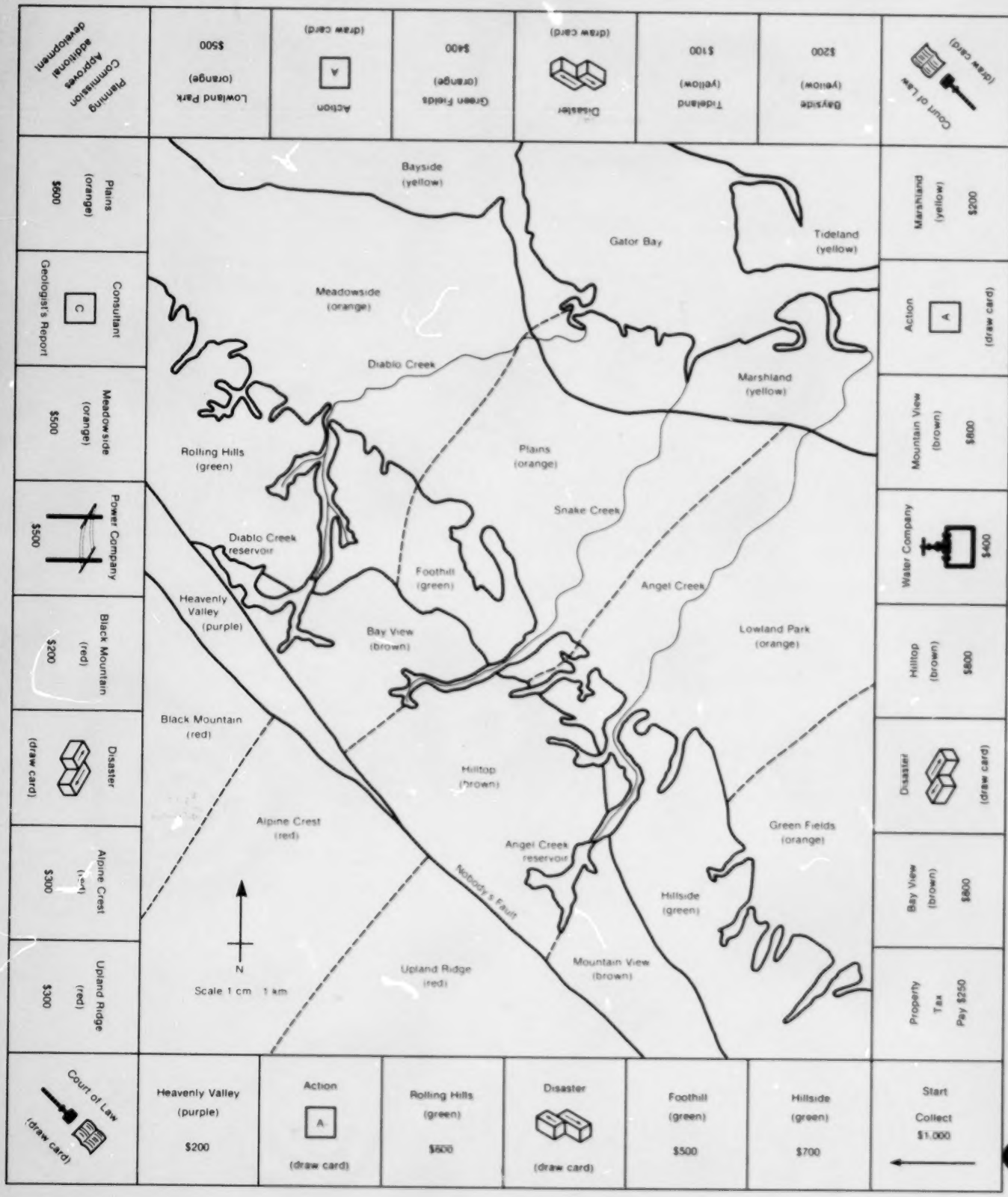
QUAKE ESTATE



Worksheet 1

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BANKER'S INSURANCE RECORD

Mark an X in the box to indicate the kind of insurance purchased on a given property. The cost of each kind of insurance for each property is indicated on the Property Card. Insurance fees are paid to the Banker. Once insurance is purchased, the money cannot be refunded. Insurance remains in force until the property is sold or returned to the bank.

	Insurance Purchased			
	Flood	Earthquake	Landslide	Fire
Alpine Crest				
Bayside				
Bayview				
Black Mountains				
Foothill				
Green Fields				
Heavenly Valley				
Hillside				
Hilltop				
Lowland Park				
Marshland				
Meadowside				
Mountain View				
Plains				
Rolling Hills				
Tideland				
Upland Ridge				

ACTION (white)

You constructed your building from fire resistant materials.

Collect $100 construction rebate from the bank.

ACTION (white)

You have located a structure on bedrock on your property.

Collect $500 from the bank for earthquake safety.

ACTION (white)

You receive a construction rebate from the city because you installed a reinforced plumbing system.

Collect $100 from the bank.

ACTION (white)

You had overhangs, judged to be dangerous in an earthquake, removed from your building.

Collect $200 insurance rebate from the bank.

ACTION (white)

You are assessed for sewage installation on all your properties.

Pay the bank $50 for each house and $100 for each condominium.

If you have no houses or condominiums, replace this card in the stack and draw another card.

ACTION (white)

You have completed a potential slide hazard survey for the area.

Collect $50 from each player who owns property.

ACTION (white)

You have purchased emergency supplies of food and water and stored them in a safe place.

Collect $100 from the bank as a disaster committee award.

ACTION (white)

You have bought open space around your development for parkland.

Collect $500 from the bank as an aesthetic environment award.

ACTION (white)

You had a soil test done on your property before you began development.

Collect $100 development rebate from the bank.

ACTION (white)

Because Heavenly Valley is always affected badly by earthquakes, the insurance company has cancelled its earthquake insurance. No refund of the cost of insurance will be made.

If no earthquake insurance has been purchased, the property owner may not buy earthquake insurance.

ACTION (white)

Advance to start and collect an additional $500 from the bank.

ACTION (white)

Because you agree to install emergency shut-off valves on your gas lines, receive a grant from the city to pay for the cost of installing the valves.

Collect $300 from the bank.

ACTION (white)

You used only reinforced concrete or masonry in your buildings as recommended by the planning commission.

Collect $500 construction rebate from the bank.

ACTION (white)

Because you have developed an emergency exit route from the urban area, collect $50 from each player and $100 from the bank.

COURT OF LAW (blue)

A dammed creek on your property overflows and floods onto adjacent land. You are judged responsible in a resulting court case.

Pay damage costs of $250.

COURT OF LAW (blue)

A tree on your property falls during a wind gust and damages a building on an adjacent property.

Pay repair damages of $300.

COURT OF LAW (blue)

You fail to file an environmental impact report for property development.

Pay fine of $350.

COURT OF LAW (blue)

A court case to settle a dispute about property boundaries is judged in your favor.

Pay lawyer's fee of $300.

COURT OF LAW (blue)

You have a grass fire on your property. Before you could reseed, rains and landsliding have occurred and cause damage to property and buildings.

Pay costs of $200.

COURT OF LAW (blue)

A court case filed by a person injured on your property is judged to be caused by your negligence.

Pay fine of $500.

COURT OF LAW (blue)

Your property has subsided and caused damage to sewage lines.

Pay repair damage costs of $150.

COURT OF LAW (blue)

Because you did not get a building permit for a development on your property, you have created a building zone violation.

Pay building zone violation fine of $100.

COURT OF LAW (blue)

You are judged guilty of causing environmental pollution.

Pay environmental pollution fine of $350.

COURT OF LAW (blue)

You have had a court case with one of your tenants.

Pay lawyer's fee of $200.

Worksheet 4

DISASTER (red)

Wind waves cause erosion along the bay. This affects Tideland (yellow) only. All property owners in this area without flood insurance must pay the amount shown for each property and for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have flood insurance pay only 50% of the amount shown on the insured properties.

Property:	$ 50
Residential	$ 50
Condominium:	$100
Shopping Center:	$200
Recreational:	$ 10

DISASTER (red)

A severe earthquake of magnitude 8.0 hits the entire area. All property owners without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have earthquake insurance pay only 50% of this amount on the insured properties.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 50	$100	$ 25	$100
Hilltop (brown):	$150	$250	$ 50	$200
Mountain (red):	$150	$250	$ 50	$200
Plains (orange):	$150	$250	$ 50	$200
Tideland (yellow):	$300	$500	$100	$400
Valley (purple):	$300	$500	$100	$500

DISASTER (red)

A lightning storm in Mountain (red) causes a grass fire which results in damage to developments in that area. All property owners in this area without fire insurance must pay the amount shown for each development on each property in the area. (If there are no developments, the property owner does not have to pay.) Property owners who have fire insurance pay only 50% of the amount shown on the insured properties.

Residential:	$100
Condominium:	$200
Shopping Center:	$400
Recreational:	$ 0

DISASTER (red)

Heavy rains and high onshore winds cause coastal flooding in the Tideland (yellow). All property owners without flood insurance must pay the amount shown for each property and for each development on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have flood insurance pay only 50% of the amount shown.

Property:	$ 50
Residential:	$100
Condominium:	$200
Shopping Center:	$400
Recreational:	$ 50

DISASTER (red)

An earthquake of magnitude 5.0 hits the entire area. Panic among people in the condominiums causes damage. Minor damage is done to residential properties. All property owners without earthquake insurance must pay the amount shown for each development on each property affected. (If there are no developments, the property owner does not have to pay.) Property owners who have earthquake insurance pay only 50% of the amount shown on the insured properties.

	Condominium	Residential
Foothill (green):	$ 50	$ 0
Hilltop (brown):	$100	$ 0
Mountain (red):	$100	$ 0
Plains (orange):	$100	$25
Tideland (yellow):	$200	$50
Valley (purple):	$200	$50

DISASTER (red)

Heavy pumping of ground water during drought causes subsidence in Tideland (yellow) and Plains (orange). All property owners in these areas pay the amount shown. There is no insurance coverage for subsidence.

	Costs	
	Tideland	Plains
Residential:	$100	$ 75
Condominium:	$200	$125
Shopping Center:	$150	$100
Recreational:	$ 0	$ 0

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DISASTER (red)

An earthquake of magnitude 6.5 occurs in the area. All property owners without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with earthquake insurance pay only 50% of this amount on the insured property.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 25	$ 50	$ 0	$ 25
Hilltop (brown):	$ 50	$100	$ 0	$ 75
Mountain (red):	$ 50	$100	$ 0	$ 75
Plains (orange):	$ 50	$100	$ 0	$ 75
Tideland (yellow):	$100	$200	$25	$150
Valley (purple):	$100	$200	$30	$100

DISASTER (red)

A large tsunami hits the Tideland (yellow) areas only. All property owners in this area without flood or earthquake insurance must pay the amount shown for the property and for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have flood insurance pay only 50% of the amount shown on the insured properties.

Property:	$100
Residential:	$200
Condominium:	$400
Shopping Center:	$600
Recreational:	$ 50

DISASTER (red)

An earthquake of magnitude 5.0 hits the entire area. All property owners without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have earthquake insurance pay only 50% of the amount on the insured properties.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 0	$ 0	$ 0	$ 0
Hilltop (brown):	$10	$ 25	$ 0	$25
Mountain (red):	$10	$ 25	$ 0	$25
Plains (orange):	$10	$ 25	$ 0	$25
Tideland (yellow):	$50	$100	$ 0	$75
Valley (purple):	$50	$100	$ 0	$75

DISASTER (red)

A small earthquake of magnitude 3.5 affects only chimneys in residential developments. Property owners in the affected areas without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with landslide insurance pay no money for earthquake damage.

Foothill (green):	$ 0
Hilltop (brown):	$10
Mountain (red):	$10
Plains (orange):	$25
Tideland (yellow):	$50
Valley (purple):	$50

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Worksheet 5 (Page 2)

DISASTER (red)

Heavy rains produce abundance of inexpensive hydroelectric power. The Power Company rebates $25 to each property owner.

DISASTER (red)

Heavy rains throughout the area cause landslides on some properties. Property owners in the affected areas without landslide insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with landslide insurance pay only 50% of the amount on the insured property.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 25	$ 50	$25	$ 50
Hilltop (brown):	$100	$200	$50	$200
Mountain (red):	$100	$200	$50	$200
Plains (orange):	$ 0	$ 0	$ 0	$ 0
Tideland (yellow):	$ 0	$ 0	$ 0	$ 0
Valley (purple):	$100	$200	$50	$200

DISASTER (red)

A minor earthquake of magnitude 6.0 occurs in the mountain area and causes cracks in the dams. All homes in flood-prone areas (orange and yellow) are evacuated. Property owners in the affected areas without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with earthquake insurance pay only 50% of this amount on the insured property.

Residential:	$100
Condominium:	$400
Shopping Center:	$400
Recreational:	$ 0

DISASTER (red)

A fire starts in Plains and is spread into the mountains by a local wind. All property owners without fire insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with fire insurance pay only 50% of the amount on insured properties.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$100	$200	$25	$200
Hilltop (brown):	$ 50	$100	$25	$100
Mountain (red):	$ 25	$ 50	$25	$ 50
Plains (orange):	$200	$400	$50	$400
Tideland (yellow):	$ 0	$ 0	$ 0	$ 0
Valley (purple):	$ 25	$ 50	$25	$ 50

DISASTER (red)

An earthquake of magnitude 6.5 causes sand boils and local "quicksand" conditions in Plains (orange) during rainy season. All property owners in the Plains without earthquake insurance must pay the amount shown for each development on each property. (If there are no developments, the property owner does not have to pay.) Property owners with insurance pay only 50% of this amount on the insured property.

Residential:	$ 50
Condominium:	$100
Shopping Center:	$150
Recreational:	$ 25

DISASTER (red)

Increased rates during a recent period of drought are now refunded to property owners. The Water Company pays $25 to the owner of each property (except Power and Water Companies).

DISASTER (red)

Creep on faults affects structures directly on fault trace in Heavenly Valley. The property owner without insurance pays the amount shown for each development. (If there are no developments, the property owner does not have to pay.) The property owner with insurance pays only 50% of the amount shown.

Residential:	$200
Condominium:	$400
Shopping Center:	$500
Recreational:	$ 0

DISASTER (red)

Persistent storms clog reservoirs. The Water Company must assume the cost of repairs. The owner of this utility must pay $500 to the bank.

DISASTER (red)

An earthquake in a remote area damages the power lines. The Power Company must assume cost of repairs. The owner of this utility must pay $500 to the bank.

DISASTER (red)

An earthquake of magnitude 4.0 occurs in the area. Only minor damage occurs in the Tideland (yellow) and Valley (purple). All property owners without earthquake insurance in these areas must pay $50 for each property. Property owners who have earthquake insurance pay only $25.

GEOLOGIST'S REPORT

Alpine Crest (red)

Sedimentary and volcanic rocks form mountains. Steep slopes prone to landslides. Potential earthquake damage slight in earthquakes of less than magnitude 5.0. Grass fires possible in summer months. No risk of floods.

Recommendations—
Purchase fire insurance.
Purchase landslide insurance.
Might consider earthquake insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Foothill (green)

Very stable sedimentary rocks, rolling hills with gentle slopes. Generally resistant to earthquake damage except for those of high magnitude. Danger from landsliding and grass fires. No danger from flooding.

Recommendations—
Purchase landslide and fire insurance.
Might consider earthquake insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Black Mountain (red)

Sedimentary and volcanic rocks form mountains. Steep slopes prone to landslides. Potential earthquake damage slight in earthquakes of less than magnitude 5.0. Grass fires possible in summer months. No risk of floods.

Recommendations—
Purchase fire insurance.
Purchase landslide insurance.
Might consider earthquake insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Rolling Hills (green)

Very stable sedimentary rocks, rolling hills with gentle slopes. Generally resistant to earthquake damage except for those of high magnitude. Danger from landsliding and grass fires. No danger from flooding.

Recommendations—
Purchase landslide and fire insurance.
Might consider earthquake insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Upland Ridge (red)

Sedimentary and volcanic rocks form mountains. Steep slopes prone to landslides. Potential earthquake damage slight in earthquakes of less than magnitude 5.0. Grass fires possible in summer months. No risk of floods.

Recommendations—
Purchase fire insurance.
Purchase landslide insurance.
Might consider earthquake insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Mountain View (brown)

Mixture of volcanic and sedimentary rocks. Hills are steep and prone to landsliding. Potential earthquake damage slight in low and moderate magnitude earthquakes. No risk of floods. Grass fires possible.

Recommendations—
Purchase landslide insurance.
Might consider earthquake and fire insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Heavenly Valley (purple)

Extensively crushed sedimentary and metamorphic rocks. Long, narrow valley with gentle slopes. High earthquake risk at most magnitudes. Frequent landslides from surrounding mountains. High fire danger during summer. No major risk from flooding.

Recommendations—
Purchase earthquake, landslide, and fire insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Bay View (brown)

Mixture of volcanic and sedimentary rocks. Hills are steep and prone to landsliding. Potential earthquake damage slight in low and moderate magnitude earthquakes. No risk of floods. Grass fires possible.

Recommendations—
Purchase landslide insurance.
Might consider earthquake and fire insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Hillside (green)

Very stable sedimentary rocks, rolling hills with gentle slopes. Generally resistant to earthquake damage except for those of high magnitude. Danger from landsliding and grass fires. No danger from flooding.

Recommendations—
Purchase landslide and fire insurance.
Might consider earthquake insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Hilltop (brown)

Mixture of volcanic and sedimentary rocks. Hills are steep and prone to landsliding. Potential earthquake damage slight in low and moderate magnitude earthquakes. No risk of floods. Grass fires possible.

Recommendations—
Purchase landslide insurance.
Might consider earthquake and fire insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Marshland (yellow)

Soft, water-logged mud and clay; poor, weak foundation materials, subject to large earthquake movements. Flooding may be caused by tsunami and river overflow. Low fire and landslide risk.

Recommendations—
Purchase earthquake and flood insurance.
No need to purchase landslide or fire insurance.

GEOLOGIST'S REPORT

Lowland Park (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood and fire insurance.
No need to purchase landslide insurance.

GEOLOGIST'S REPORT

Bayside (yellow)

Soft, water-logged mud and clay; poor, weak foundation materials, subject to large earthquake movements. Flooding may be caused by tsunami and river overflow. Low fire and landslide risk.

Recommendations—
Purchase earthquake and flood insurance.
No need to purchase landslide or fire insurance.

GEOLOGIST'S REPORT

Meadowside (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood and fire insurance.
No need to purchase landslide insurance.

GEOLOGIST'S REPORT

Tideland (yellow)

Soft, water-logged mud and clay; poor, weak foundation materials, subject to large earthquake movements. Flooding may be caused by tsunami and river overflow. Low fire and landslide risk.

Recommendations—
Purchase earthquake and flood insurance.
No need to purchase landslide or fire insurance.

GEOLOGIST'S REPORT

Plains (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood, and fire insurance.
No need to purchase landslide insurance.

GEOLOGIST'S REPORT

Green Fields (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood, and fire insurance.
No need to purchase landslide insurance.

Worksheet 6 (Page 2)

UPLAND RIDGE (red)

Land cost:	$ 300
Development	
Recreational:	$ 100
Residential:	$ 400
Condominium:	$ 800
Shopping Center:	$2,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$30 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

HEAVENLY VALLEY (purple)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 400
Condominium:	$ 800
Shopping Center:	$1,200
Insurance	
Flood	$ 50
Earthquake	$ 150
Landslide	$ 100
Fire	$ 50

Rent
$20 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

ROLLING HILLS (green)

Land cost:	$ 600
Development	
Recreational:	$ 500
Residential:	$ 900
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$60 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

FOOTHILL (green)

Land cost:	$ 500
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$1,500
Shopping Center:	$3,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$50 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

HILLSIDE (green)

Land cost:	$ 700
Development	
Recreational:	$ 500
Residential:	$1,000
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$70 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

ALPINE CREST (red)

Land cost:	$ 300
Development	
Recreational:	$ 100
Residential:	$ 400
Condominium:	$ 800
Shopping Center:	$2,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$30 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

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BLACK MOUNTAIN (red)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 300
Condominium:	$ 700
Shopping Center:	$1,500
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$20 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

MEADOWSIDE (orange)

Land cost:	$ 500
Development	
Recreational:	$ 300
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$50 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

PLAINS (orange)

Land cost:	$ 600
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$60 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

LOWLAND PARK (orange)

Land cost:	$ 500
Development	
Recreational:	$ 300
Residential:	$ 800
Condominium:	$3,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$50 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

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Worksheet 7 (Page 2)

POWER COMPANY (white)

Utility cost	$ 500
Utility fees	$ 50

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WATER COMPANY (white)

Utility cost	$ 400
Utility fees	$ 50

MARSHLAND (yellow)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 300
Condominium:	$ 500
Shopping Center:	$1,000
Insurance	
Flood	$ 100
Earthquake	$ 100
Landslide	$ 50
Fire	$ 50

Rent

$20 plus 10% of total value of all developments made.

Geologist's Report Fee

$20

BAYSIDE (yellow)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 300
Condominium:	$ 500
Shopping Center:	$1,000
Insurance	
Flood	$ 100
Earthquake	$ 100
Landslide	$ 50
Fire	$ 50

Rent

$20 plus 10% of total value of all developments made.

Geologist's Report Fee

$20

BAY VIEW (brown)

Land cost:	$ 800
Development	
Recreational:	$ 500
Residential:	$ 800
Condominium:;	$2,000
Shopping Center:	$3,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent

$80 plus 10% of total value of all developments made.

Geologist's Report Fee

$20

TIDELAND (yellow)

Land cost:	$ 100
Development	
Recreational:	$ 100
Residential:	$ 200
Condominium:	$ 400
Shopping Center:	$ 900
Insurance	
Flood	$ 100
Earthquake	$ 100
Landslide	$ 50
Fire	$ 50

Rent

$10 plus 10% of total value of all developments made.

Geologist's Report Fee

$20

HILLTOP (brown)

Land cost:	$ 800
Development	
Recreational:	$ 500
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent

$80 plus 10% of total value of all developments made.

Geologist's Report Fee

$25

GREEN FIELDS (orange)

Land cost:	$ 400
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent

$40 plus 10% of total value of all developments made.

Geologist's Report Fee

$30

MOUNTAIN VIEW (brown)

Land cost:	$ 800
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$3,500
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	150
Fire	$ 150

Rent

$80 plus 10% of total value of all developments made.

Geologist's Report Fee

$25

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NAGT Crustal Evolution Education Project Modules

CEEP Modules are listed here in alphabetical order. Each Module is designed for use in the number of class periods indicated. For suggested sequences of CEEP Modules to cover specific topics and for correlation of CEEP Modules to standard earth science textbooks, consult Ward's descriptive literature on CEEP. The Catalog Numbers shown here refer to the CLASS PACK of each Module consisting of a Teacher's Guide and 30 copies of the Student Investigation. See Ward's descriptive literature for alternate order quantities.

CEEP Module	Class Periods	CLASS PACK Catalog No.
• A Sea-floor Mystery: Mapping Polarity Reversals	3	34 W 1201
• Continents And Ocean Basins: Floaters And Sinkers	3-5	34 W 1202
• Crustal Movement: A Major Force In Evolution	2-3	34 W 1203
• Deep Sea Trenches And Radioactive Waste	1	34 W 1204
• Drifting Continents And Magnetic Fields	3	34 W 1205
• Drifting Continents And Wandering Poles	4	34 W 1206
• Earthquakes And Plate Boundaries	2	34 W 1207
• Fossils As Clues To Ancient Continents	2-3	34 W 1208
• Hot Spots In The Earth's Crust	3	34 W 1209
• How Do Continents Split Apart?	2	34 W 1210
• How Do Scientists Decide Which Is The Better Theory?	2	34 W 1211
• How Does Heat Flow Vary In The Ocean Floor?	2	34 W 1212
• How Fast Is The Ocean Floor Moving?	2-3	34 W 1213
• Iceland: The Case Of The Splitting Personality	3	34 W 1214
• Imaginary Continents: A Geological Puzzle	2	34 W 1215
• Introduction To Lithospheric Plate Boundaries	1-2	34 W 1216
• Lithospheric Plates And Ocean Basin Topography	2	34 W 1217
• Locating Active Plate Boundaries By Earthquake Data	2-3	34 W 1218
• Measuring Continental Drift: The Laser Ranging Experiment	2	34 W 1219
• Microfossils, Sediments And Sea-floor Spreading	4	34 W 1220
• Movement Of The Pacific Ocean Floor	2	34 W 1221
• Plate Boundaries And Earthquake Predictions	2	34 W 1222
• Plotting The Shape Of The Ocean Floor	2-3	34 W 1223
• Quake Estate (board game)	3	34 W 1224
• Spreading Sea Floors And Fractured Ridges	2	34 W 1225
• The Rise And Fall Of The Bering Land Bridge	2	34 W 1227
• Tropics In Antarctica?	2	34 W 1228
• Volcanoes: Where And Why?	2	34 W 1229
• What Happens When Continents Collide?	2	34 W 1230
• When A Piece Of A Continent Breaks Off	2	34 W 1231
• Which Way Is North?	3	34 W 1232
• Why Does Sea Level Change?	2-3	34 W 1233

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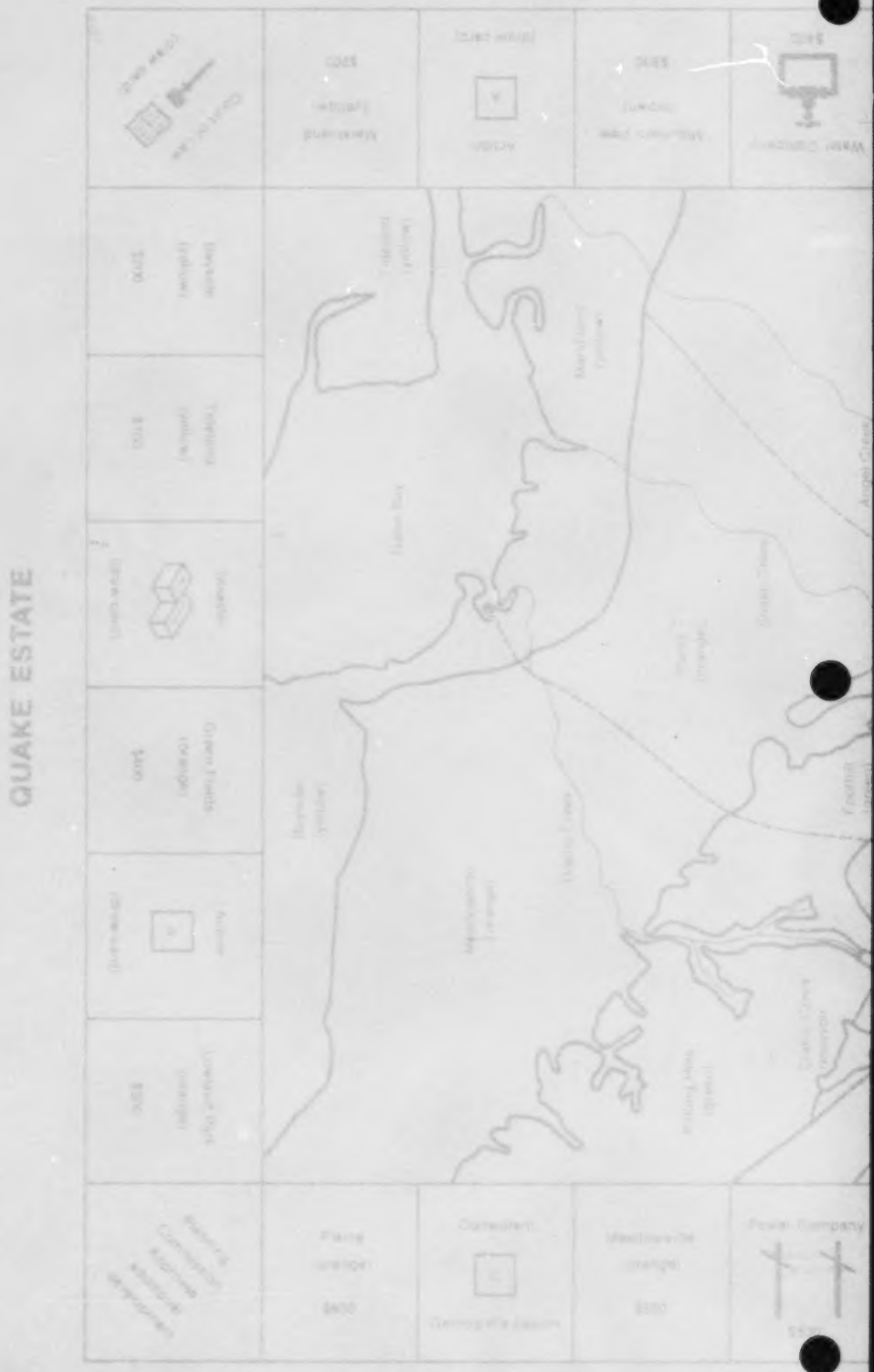

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CRUSTAL EVOLUTION EDUCATION PROJECT

NAME DATE

Student Investigation

Catalog No. 34W1124

Quake Estate (board game)

INTRODUCTION

Quake Estate is a game of real environmental problems and decisions. You will play the part of a geologist, investor, and land developer. The game board is a simplified version of an area located at a major plate boundary in California. This area has many hazards. These hazards include earthquakes, landslides, fires, and floods. Geologists, land developers and residents have many problems because of these hazards. The object of the game is to acquire the most money and property. Understanding geologic hazards and their effects on land development and use will help you win the game.

OBJECTIVES

After you have completed this activity, you should be able to:

1. Identify the geologic hazards in an earthquake-prone area.
2. Identify the probable effects of these hazards on the land and development in the area.
3. State measures that can be employed to minimize the effect of these hazards.

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PROCEDURE

Materials: complete set of game materials

RULES

1. Two to four players may play the game. Team play is also an alternative.

2. A Banker must be selected who will handle the finances during play. This can be done by each player throwing the dice, with the highest throw becoming the Banker. Because the Banker is also a player in the game, he or she must also maintain money as well.

Each group of game cards is shuffled and placed face down beside the Banker.

3. To start the game, each player draws a Property Card from the Banker. This becomes the principal place of residence. If a player draws the Water or Power Company, these are put back into the pile and the player draws again.

The players place their markers at Start and collect $1,000 each from the Banker (1-$500, 2-$100, 3-$50, 5-$20, 4-$10, and 2-$5). The order of play is clockwise, with the person to the immediate left of the Banker going first.

4. To advance on the board, each player in turn throws the dice and moves his or her marker the number of spaces indicated.

If doubles are thrown, the player receives an additional turn. If doubles are thrown again the dice are passed to the next player and no additional turn is taken.

If the player lands on an unowned property square, it may be purchased at that time for the amount shown on the square. If the property square is owned, including the Water and Power Companies, the player must pay the rent to the owner shown on the Property Card. Rent is the fee shown on the Property Card plus 10% of total value of all developments made. Insurance is not considered a development.

In addition to the property squares, other squares around the board are named according to matching cards. When landing on these squares, the player draws the appropriate card:

ACTION—indicates some money the player is to pay out or receive.

DISASTER—indicates some geologic hazard that affects all players holding property in the areas indicated.

COURT OF LAW—requires the player to pay out a fee for some legal action.

CONSULTANT—player receives, at no cost, a Geologist's Report about one of his or her properties. (Otherwise, players have the option to purchase the Geologist's Report for the fee shown on the Property Card. The Geologist's Report may be purchased at any time during the player's turn). Geologist's Reports will be helpful in planning developments.

PLANNING COMMISSION—player is given a variance to make a total of three developments on a piece of property, rather than being limited to two as is normally the case (see DEVELOPING LAND). The third development must be made during that move and may not be "saved."

SPECIAL PROPERTY TAXES—player must pay the amount indicated to the Bank.

5. Each time a player passes Start, the player collects $1000 from the Banker.

6. If a player runs out of money but holds property, he or she has the option to sell developments back to the bank at 50% of their original cost, or a property may be sold to any of the other players for the highest bid.

7. The game is over when time has run out or when only one player is left. When time has run out, the winner is the player with the greatest wealth. Wealth is determined by adding the cash and actual cost of all property and developments held by each player. Insurance is not included.

DEVELOPING LAND

All of the property squares except the Water and Power Companies may be developed in only two of the following ways: Recreational Area, Residential Area, Condominium and Shopping Center.

Land may be developed at the time it is purchased or when the player passes the Start square. The cost for each development alternative is shown on the Property Card. In developing the land the player should consider the possible geologic hazards of the property. A player may purchase the Geologist's Report on a piece of property at any time during the player's turn by paying the fee shown on the Property Card. When development occurs, the player puts an appropriate structure on the property. Developments cannot be moved from one property to another.

INSURANCE

Insurance against floods, earthquakes, landslides and fire may be purchased from the bank at the time the property is purchased, developed, or when the player passes Start. The Banker records the kinds of insurance purchased on each property on the Banker's Insurance Record. The cost of the various kinds of insurance are shown on the Property Cards. Insurance covers 100% of the cost of property.

Once purchased, the insurance remains active on a piece of property as long as the property is not sold. When property is sold to the bank or another player, the insurance is cancelled. The new owner must buy new insurance if desired.

Damage caused by tsunami can be covered either by flood or earthquake insurance. Before starting the game, the players must decide which insurance policy will cover damage caused by tsunami.

Insurance may not be sold back to the bank (although developments or the property may be). It has no "trade in" value.

Good luck and plan your investments wisely!

SUMMARY QUESTIONS

1. What is the greatest geologic hazard in a zone of active faulting?

2. What is the most significant hazard associated with dams in an area of active faulting?

3. What is the greatest hazard associated with coastal areas prone to earthquakes?

4. Why may it be dangerous to build a home on a flood plain of a river?

5. What are the factors you would consider when buying a home in an area prone to earthquakes?

REFERENCE

Iacopi, R. A., 1964, *Earthquake country.* A Sunset Book, Menlo Park, California, Lane Publishing Company, 192 p.

Worksheet 1

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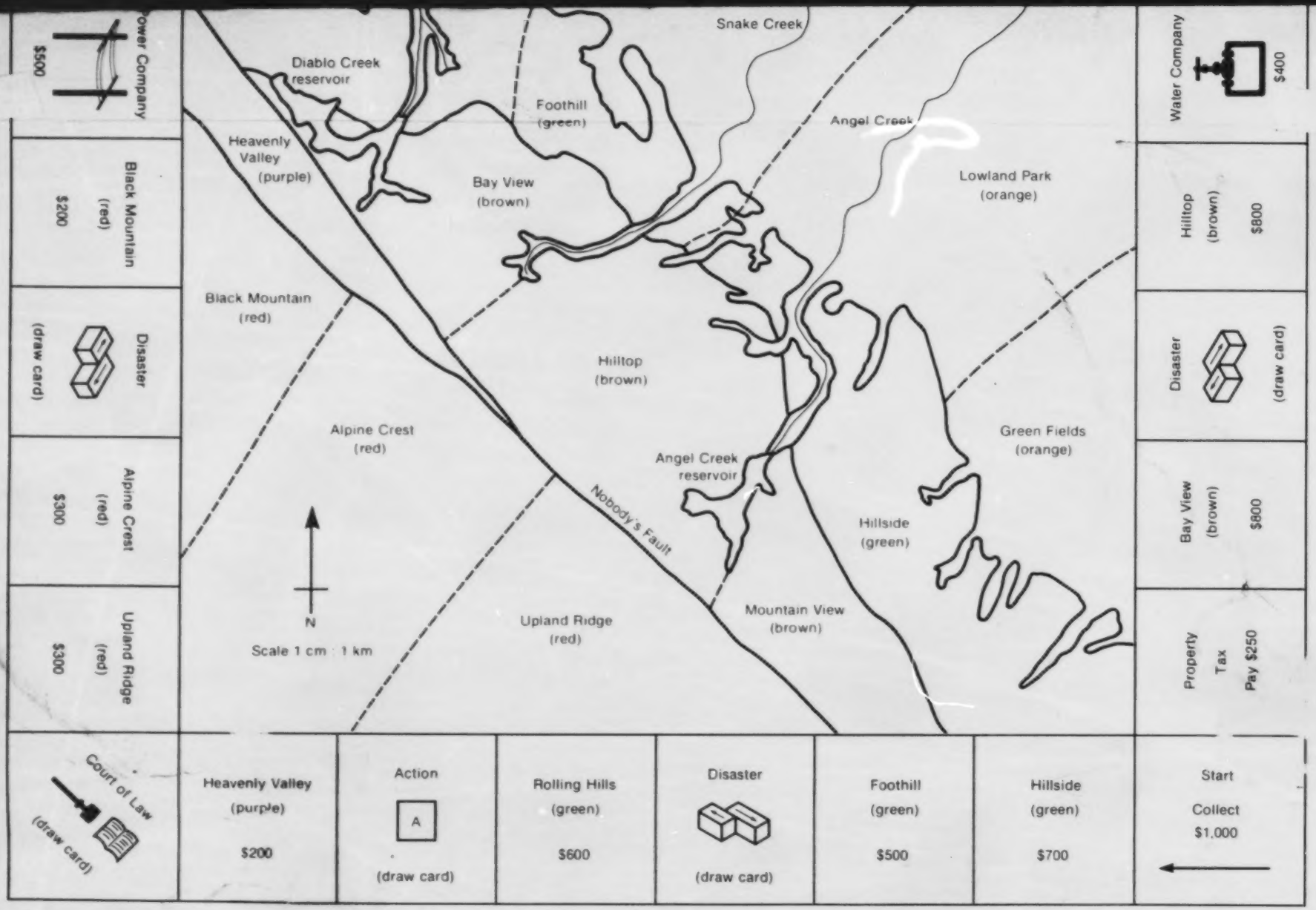
QUAKE ESTATE

Planning Commission Approves additional development	$500 Lowland Park (orange)	(draw card) A Action	$400 Green Fields (orange)	(draw card) Disaster	$100 Tideland (yellow)	$200 Bayside (yellow)	Court of Law (draw card)

$600 Plains (orange)	Bayside (yellow)	Gator Bay / Tideland (yellow)	Marshland (yellow) $200
Consultant C Geologist's Report	Meadowside (orange)	Diablo Creek	Action A (draw card)
Meadowside (orange) $500	Rolling Hills (green)	Plains (orange) / Marshland (yellow)	Mountain View (brown) $800


Power Company
$500
Diablo Creek reservoir
Snake Creek
Foothill (green)
Angel Creek
Water Company
$400
Heavenly Valley (purple)
Bay View (brown)
Lowland Park (orange)
Black Mountain (red)
$200
Hilltop (brown)
$800
Black Mountain (red)
Disaster
(draw card)
Hilltop (brown)
Disaster
(draw card)
Alpine Crest (red)
Green Fields (orange)
Angel Creek reservoir
Alpine Crest (red)
$300
Bay View (brown)
$800
Nobody's Fault
Hillside (green)
N
Scale 1 cm : 1 km
Upland Ridge (red)
Mountain View (brown)
Upland Ridge (red)
$300
Property Tax Pay $250
Court of Law
(draw card)
Heavenly Valley (purple)
$200
Action
A
(draw card)
Rolling Hills (green)
$600
Disaster
(draw card)
Foothill (green)
$500
Hillside (green)
$700
Start
Collect $1,000

BANKER'S INSURANCE RECORD

Mark an X in the box to indicate the kind of insurance purchased on a given property. The cost of each kind of insurance for each property is indicated on the Property Card. Insurance fees are paid to the Banker. Once insurance is purchased, the money cannot be refunded. Insurance remains in force until the property is sold or returned to the bank.

	Insurance Purchased			
	Flood	Earthquake	Landslide	Fire
Alpine Crest				
Bayside				
Bayview				
Black Mountains				
Foothill				
Green Fields				
Heavenly Valley				
Hillside				
Hilltop				
Lowland Park				
Marshland				
Meadowside				
Mountain View				
Plains				
Rolling Hills				
Tideland				
Upland Ridge				

ACTION (white)

You constructed your building from fire resistant materials.

Collect $100 construction rebate from the bank.

ACTION (white)

You have located a structure on bedrock on your property.

Collect $500 from the bank for earthquake safety.

ACTION (white)

You receive a construction rebate from the city because you installed a reinforced plumbing system.

Collect $100 from the bank.

ACTION (white)

You had overhangs, judged to be dangerous in an earthquake, removed from your building.

Collect $200 insurance rebate from the bank.

ACTION (white)

You are assessed for sewage installation on all your properties.

Pay the bank $50 for each house and $100 for each condominium.

If you have no houses or condominiums, replace this card in the stack and draw another card.

ACTION (white)

You have completed a potential slide hazard survey for the area.

Collect $50 from each player who owns property.

ACTION (white)

You have purchased emergency supplies of food and water and stored them in a safe place.

Collect $100 from the bank as a disaster committee award.

ACTION (white)

You have bought open space around your development for parkland.

Collect $500 from the bank as an aesthetic environment award.

ACTION (white)

You had a soil test done on your property before you began development.

Collect $100 development rebate from the bank.

ACTION (white)

Because Heavenly Valley is always affected badly by earthquakes, the insurance company has cancelled its earthquake insurance. No refund of the cost of insurance will be made.

If no earthquake insurance has been purchased, the property owner may not buy earthquake insurance.

ACTION (white)

Advance to start and collect an additional $500 from the bank.

ACTION (white)

Because you agree to install emergency shut-off valves on your gas lines, receive a grant from the city to pay for the cost of installing the valves.

Collect $300 from the bank.

ACTION (white)

You used only reinforced concrete or masonry in your buildings as recommended by the planning commission.

Collect $500 construction rebate from the bank.

ACTION (white)

Because you have developed an emergency exit route from the urban area, collect $50 from each player and $100 from the bank.

COURT OF LAW (blue)

A dammed creek on your property overflows and floods onto adjacent land. You are judged responsible in a resulting court case.

Pay damage costs of $250.

COURT OF LAW (blue)

A tree on your property falls during a wind gust and damages a building on an adjacent property.

Pay repair damages of $300.

COURT OF LAW (blue)

You fail to file an environmental impact report for property development.

Pay fine of $350.

COURT OF LAW (blue)

A court case to settle a dispute about property boundaries is judged in your favor.

Pay lawyer's fee of $300.

COURT OF LAW (blue)

You have a grass fire on your property. Before you could reseed, rains and landsliding have occurred and cause damage to property and buildings.

Pay costs of $200.

COURT OF LAW (blue)

A court case filed by a person injured on your property is judged to be caused by your negligence.

Pay fine of $500.

COURT OF LAW (blue)

Your property has subsided and caused damage to sewage lines.

Pay repair damage costs of $150.

COURT OF LAW (blue)

Because you did not get a building permit for a development on your property, you have created a building zone violation.

Pay building zone violation fine of $100.

COURT OF LAW (blue)

You are judged guilty of causing environmental pollution.

Pay environmental pollution fine of $350.

COURT OF LAW (blue)

You have had a court case with one of your tenants.

Pay lawyer's fee of $200.

DISASTER (red)

Wind waves cause erosion along the bay. This affects Tideland (yellow) only. All property owners in this area without flood insurance must pay the amount shown for each property and for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have flood insurance pay only 50% of the amount shown on the insured properties.

Property:	$ 50
Residential	$ 50
Condominium:	$100
Shopping Center:	$200
Recreational:	$ 10

DISASTER (red)

A severe earthquake of magnitude 8.0 hits the entire area. All property owners without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have earthquake insurance pay only 50% of this amount on the insured properties.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 50	$100	$ 25	$100
Hilltop (brown):	$150	$250	$ 50	$200
Mountain (red):	$150	$250	$ 50	$200
Plains (orange):	$150	$250	$ 50	$200
Tideland (yellow):	$300	$500	$100	$400
Valley (purple):	$300	$500	$100	$500

DISASTER (red)

A lightning storm in Mountain (red) causes a grass fire which results in damage to developments in that area. All property owners in this area without fire insurance must pay the amount shown for each development on each property in the area. (If there are no developments, the property owner does not have to pay.) Property owners who have fire insurance pay only 50% of the amount shown on the insured properties.

Residential:	$100
Condominium:	$200
Shopping Center:	$400
Recreational:	$ 0

DISASTER (red)

Heavy rains and high onshore winds cause coastal flooding in the Tideland (yellow). All property owners without flood insurance must pay the amount shown for each property and for each development on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have flood insurance pay only 50% of the amount shown.

Property:	$ 50
Residential:	$100
Condominium:	$200
Shopping Center:	$400
Recreational:	$ 50

DISASTER (red)

An earthquake of magnitude 5.0 hits the entire area. Panic among people in the condominiums causes damage. Minor damage is done to residential properties. All property owners without earthquake insurance must pay the amount shown for each development on each property affected. (If there are no developments, the property owner does not have to pay.) Property owners who have earthquake insurance pay only 50% of the amount shown on the insured properties.

	Condominium	Residential
Foothill (green):	$ 50	$ 0
Hilltop (brown):	$100	$ 0
Mountain (red):	$100	$ 0
Plains (orange):	$100	$25
Tideland (yellow):	$200	$50
Valley (purple):	$200	$50

DISASTER (red)

Heavy pumping of ground water during drought causes subsidence in Tideland (yellow) and Plains (orange). All property owners in these areas pay the amount shown. There is no insurance coverage for subsidence.

	Costs	
	Tideland	Plains
Residential:	$100	$ 75
Condominium:	$200	$125
Shopping Center:	$150	$100
Recreational:	$ 0	$ 0

DISASTER (red)

An earthquake of magnitude 6.5 occurs in the area. All property owners without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with earthquake insurance pay only 50% of this amount on the insured property.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 25	$ 50	$ 0	$ 25
Hilltop (brown):	$ 50	$100	$ 0	$ 75
Mountain (red):	$ 50	$100	$ 0	$ 75
Plains (orange):	$ 50	$100	$ 0	$ 75
Tideland (yellow):	$100	$200	$25	$150
Valley (purple):	$100	$200	$30	$100

DISASTER (red)

A large tsunami hits the Tideland (yellow) areas only. All property owners in this area without flood or earthquake insurance must pay the amount shown for the property and for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have flood insurance pay only 50% of the amount shown on the insured properties.

Property:	$100
Residential:	$200
Condominium:	$400
Shopping Center:	$600
Recreational:	$ 50

DISASTER (red)

An earthquake of magnitude 5.0 hits the entire area. All property owners without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners who have earthquake insurance pay only 50% of the amount on the insured properties.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 0	$ 0	$ 0	$ 0
Hilltop (brown):	$10	$ 25	$ 0	$25
Mountain (red):	$10	$ 25	$ 0	$25
Plains (orange):	$10	$ 25	$ 0	$25
Tideland (yellow):	$50	$100	$ 0	$75
Valley (purple):	$50	$100	$ 0	$75

DISASTER (red)

A small earthquake of magnitude 3.5 affects only chimneys in residential developments. Property owners in the affected areas without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with landslide insurance pay no money for earthquake damage.

Foothill (green):	$ 0
Hilltop (brown):	$10
Mountain (red):	$10
Plains (orange):	$25
Tideland (yellow):	$50
Valley (purple):	$50

DISASTER (red)

Heavy rains produce abundance of inexpensive hydroelectric power. The Power Company rebates $25 to each property owner.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$ 25	$ 50	$25	$ 50
Hilltop (brown):	$100	$200	$50	$200
Mountain (red):	$100	$200	$50	$200
Plains (orange):	$ 0	$ 0	$ 0	$ 0
Tideland (yellow):	$ 0	$ 0	$ 0	$ 0
Valley (purple):	$100	$200	$50	$200

DISASTER (red)

Heavy rains throughout the area cause landslides on some properties. Property owners in the affected areas without landslide insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with landslide insurance pay only 50% of the amount on the insured property.

DISASTER (red)

A minor earthquake of magnitude 6.0 occurs in the mountain area and causes cracks in the dams. All homes in flood-prone areas (orange and yellow) are evacuated. Property owners in the affected areas without earthquake insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with earthquake insurance pay only 50% of this amount on the insured property.

Residential:	$100
Condominium:	$400
Shopping Center:	$400
Recreational:	$ 0

DISASTER (red)

A fire starts in Plains and is spread into the mountains by a local wind. All property owners without fire insurance must pay the amount shown for each development made on each property. (If there are no developments, the property owner does not have to pay.) Property owners with fire insurance pay only 50% of the amount on insured properties.

	Residential	Condominium	Recreational	Shopping Center
Foothill (green):	$100	$200	$25	$200
Hilltop (brown):	$ 50	$100	$25	$100
Mountain (red):	$ 25	$ 50	$25	$ 50
Plains (orange):	$200	$400	$50	$400
Tideland (yellow):	$ 0	$ 0	$ 0	$ 0
Valley (purple):	$ 25	$ 50	$25	$ 50

DISASTER (red)

An earthquake of magnitude 6.5 causes sand boils and local "quicksand" conditions in Plains (orange) during rainy season. All property owners in the Plains without earthquake insurance must pay the amount shown for each development on each property. (If there are no developments, the property owner does not have to pay.) Property owners with insurance pay only 50% of this amount on the insured property.

Residential:	$ 50
Condominium:	$100
Shopping Center:	$150
Recreational:	$ 25

DISASTER (red)

Increased rates during a recent period of drought are now refunded to property owners. The Water Company pays $25 to the owner of each property (except Power and Water Companies).

DISASTER (red)

Creep on faults affects structures directly on fault trace in Heavenly Valley. The property owner without insurance pays the amount shown for each development. (If there are no developments, the property owner does not have to pay.) The property owner with insurance pays only 50% of the amount shown.

Residential:	$200
Condominium:	$400
Shopping Center:	$500
Recreational:	$ 0

DISASTER (red)

Persistent storms clog reservoirs. The Water Company must assume the cost of repairs. The owner of this utility must pay $500 to the bank.

DISASTER (red)

An earthquake in a remote area damages the power lines. The Power Company must assume cost of repairs. The owner of this utility must pay $500 to the bank.

DISASTER (red)

An earthquake of magnitude 4.0 occurs in the area. Only minor damage occurs in the Tideland (yellow) and Valley (purple). All property owners without earthquake insurance in these areas must pay $50 for each property. Property owners who have earthquake insurance pay only $25.

GEOLOGIST'S REPORT

Alpine Crest (red)

Sedimentary and volcanic rocks form mountains. Steep slopes prone to landslides. Potential earthquake damage slight in earthquakes of less than magnitude 5.0. Grass fires possible in summer months. No risk of floods.

Recommendations—
Purchase fire insurance.
Purchase landslide insurance.
Might consider earthquake insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Foothill (green)

Very stable sedimentary rocks, rolling hills with gentle slopes. Generally resistant to earthquake damage except for those of high magnitude. Danger from landsliding and grass fires. No danger from flooding.

Recommendations—
Purchase landslide and fire insurance.
Might consider earthquake insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Black Mountain (red)

Sedimentary and volcanic rocks form mountains. Steep slopes prone to landslides. Potential earthquake damage slight in earthquakes of less than magnitude 5.0. Grass fires possible in summer months. No risk of floods.

Recommendations—
Purchase fire insurance.
Purchase landslide insurance.
Might consider earthquake insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Rolling Hills (green)

Very stable sedimentary rocks, rolling hills with gentle slopes. Generally resistant to earthquake damage except for those of high magnitude. Danger from landsliding and grass fires. No danger from flooding.

Recommendations—
Purchase landslide and fire insurance.
Might consider earthquake insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Upland Ridge (red)

Sedimentary and volcanic rocks form mountains. Steep slopes prone to landslides. Potential earthquake damage slight in earthquakes of less than magnitude 5.0. Grass fires possible in summer months. No risk of floods.

Recommendations—
Purchase fire insurance.
Purchase landslide insurance.
Might consider earthquake insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Mountain View (brown)

Mixture of volcanic and sedimentary rocks. Hills are steep and prone to landsliding. Potential earthquake damage slight in low and moderate magnitude earthquakes. No risk of floods. Grass fires possible.

Recommendations—
Purchase landslide insurance.
Might consider earthquake and fire insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Heavenly Valley (purple)

Extensively crushed sedimentary and metamorphic rocks. Long, narrow valley with gentle slopes. High earthquake risk at most magnitudes. Frequent landslides from surrounding mountains. High fire danger during summer. No major risk from flooding.

Recommendations—
Purchase earthquake, landslide, and fire insurance.
No need to purchase flood incurance.

GEOLOGIST'S REPORT

Bay View (brown)

Mixture of volcanic and sedimentary rocks. Hills are steep and prone to landsliding. Potential earthquake damage slight in low and moderate magnitude earthquakes. No risk of floods. Grass fires possible.

Recommendations—
Purchase landslide insurance.
Might consider earthquake and fire insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Hillside (green)

Very stable sedimentary rocks, rolling hills with gentle slopes. Generally resistant to earthquake damage except for those of high magnitude. Danger from landsliding and grass fires. No danger from flooding.

Recommendations—
Purchase landslide and fire insurance.
Might consider earthquake insurance.
No need to purchase flood insurance.

GEOLOGIST'S REPORT

Hilltop (brown)

Mixture of volcanic and sedimentary rocks. Hills are steep and prone to landsliding. Potential earthquake damage slight in low and moderate magnitude earthquakes. No risk of floods. Grass fires possible.

Recommendations—
Purchase landslide insurance.
Might consider earthquake and fire insurance.
No need for flood insurance.

GEOLOGIST'S REPORT

Marshland (yellow)

Soft, water-logged mud and clay; poor, weak foundation materials, subject to large earthquake movements. Flooding may be caused by tsunami and river overflow. Low fire and landslide risk.

Recommendations—
Purchase earthquake and flood insurance.
No need to purchase landslide or fire insurance.

GEOLOGIST'S REPORT

Lowland Park (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood and fire insurance.
No need to purchase landslide insurance.

GEOLOGIST'S REPORT

Bayside (yellow)

Soft, water-logged mud and clay; poor, weak foundation materials, subject to large earthquake movements. Flooding may be caused by tsunami and river overflow. Low fire and landslide risk.

Recommendations—
Purchase earthquake and flood insurance.
No need to purchase landslide or fire insurance.

GEOLOGIST'S REPORT

Meadowside (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood and fire insurance.
No need to purchase landslide insurance.

GEOLOGIST'S REPORT

Tideland (yellow)

Soft, water-logged mud and clay; poor, weak foundation materials, subject to large earthquake movements. Flooding may be caused by tsunami and river overflow. Low fire and landslide risk.

Recommendations—
Purchase earthquake and flood insurance.
No need to purchase landslide or fire insurance.

GEOLOGIST'S REPORT

Plains (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood, and fire insurance.
No need to purchase landslide insurance.

GEOLOGIST'S REPORT

Green Fields (orange)

Poorly compacted sedimentary rock. High groundwater levels, good foundation materials and gentle slopes. Structures react well in low to moderate earthquakes. Danger of flooding from rivers. Susceptible to periodic grass fires. Low landslide risk.

Recommendations—
Might consider purchasing earthquake, flood, and fire insurance.
No need to purchase landslide insurance.

Worksheet 6 (Page 2)

Worksheet 7 (Page 1)

UPLAND RIDGE (red)

Land cost:	$ 300
Development	
Recreational:	$ 100
Residential:	$ 400
Condominium:	$ 800
Shopping Center:	$2,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$30 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

HEAVENLY VALLEY (purple)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 400
Condominium:	$ 800
Shopping Center:	$1,200
Insurance	
Flood	$ 50
Earthquake	$ 150
Landslide	$ 100
Fire	$ 50

Rent
$20 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

ROLLING HILLS (green)

Land cost:	$ 600
Development	
Recreational:	$ 500
Residential:	$ 900
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$60 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

FOOTHILL (green)

Land cost:	$ 500
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$1,500
Shopping Center:	$3,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$50 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

HILLSIDE (green)

Land cost:	$ 700
Development	
Recreational:	$ 500
Residential:	$1,000
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$70 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

ALPINE CREST (red)

Land cost:	$ 300
Development	
Recreational:	$ 100
Residential:	$ 400
Condominium:	$ 800
Shopping Center:	$2,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$30 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

BLACK MOUNTAIN (red)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 300
Condominium:	$ 700
Shopping Center:	$1,500
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$20 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

MEADOWSIDE (orange)

Land cost:	$ 500
Development	
Recreational:	$ 300
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$50 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

PLAINS (orange)

Land cost:	$ 600
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$60 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

LOWLAND PARK (orange)

Land cost:	$ 500
Development	
Recreational:	$ 300
Residential:	$ 800
Condominium:	$3,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$50 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

Worksheet 7 (Page 2)

MARSHLAND (yellow)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 300
Condominium:	$ 500
Shopping Center:	$1,000
Insurance	
Flood	$ 100
Earthquake	$ 100
Landslide	$ 50
Fire	$ 50

Rent
$20 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

BAYSIDE (yellow)

Land cost:	$ 200
Development	
Recreational:	$ 100
Residential:	$ 300
Condominium:	$ 500
Shopping Center:	$1,000
Insurance	
Flood	$ 100
Earthquake	$ 100
Landslide	$ 50
Fire	$ 50

Rent
$20 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

TIDELAND (yellow)

Land cost:	$ 100
Development	
Recreational:	$ 100
Residential:	$ 200
Condominium:	$ 400
Shopping Center:	$ 900
Insurance	
Flood	$ 100
Earthquake	$ 100
Landslide	$ 50
Fire	$ 50

Rent
$10 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

GREEN FIELDS (orange)

Land cost:	$ 400
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 100
Earthquake	$ 150
Landslide	$ 100
Fire	$ 100

Rent
$40 plus 10% of total value of all developments made.

Geologist's Report Fee
$30

POWER COMPANY (white)

Utility cost	$ 500
Utility fees	$ 50

WATER COMPANY (white)

Utility cost	$ 400
Utility fees	$ 50

BAY VIEW (brown)

Land cost:	$ 800
Development	
Recreational:	$ 500
Residential:	$ 800
Condominium::	$2,000
Shopping Center:	$3,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$80 plus 10% of total value of all developments made.

Geologist's Report Fee
$20

HILLTOP (brown)

Land cost:	$ 800
Development	
Recreational:	$ 500
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$4,000
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	$ 150
Fire	$ 150

Rent
$80 plus 10% of total value of all developments made.

Geologist's Report Fee
$25

MOUNTAIN VIEW (brown)

Land cost:	$ 800
Development	
Recreational:	$ 400
Residential:	$ 800
Condominium:	$2,000
Shopping Center:	$3,500
Insurance	
Flood	$ 50
Earthquake	$ 100
Landslide	150
Fire	$ 150

Rent
$80 plus 10% of total value of all developments made.

Geologist's Report Fee
$25